

December 15-17, 2021



ICAEAST'21



International Conference on Advances in Engineering, Architecture, Science and Technology



ERZURUM TECHNICAL UNIVERSITY, FACULTY OF ENGINEERING and ARCHITECTURE, ERZURUM/TURKEY

**MUHAMMED SAYRAÇ**

has participated in the “ **1<sup>st</sup> International Conference on Advances in Engineering, Architecture, Science and Technology** ” with the paper entitled

*Effect of Ultrashort Laser Pulse Shape on the Dipole Spectrum of a Single Electron*  
Muhammed SAYRAÇ

which has been held in Erzurum, Turkey on December 15-17, 2021.

**Prof. Dr. Ali Fatih YETİM**  
General Chair

**Assoc. Prof. Dr. Salih AKPINAR**  
Conference Chair

December 15-17, 2021



06.12.2021

Dear **Muhammed Sayrac**,

We are pleased to inform you that your paper titled “**Effect of Ultrashort Laser Pulse Shape on the Dipole Spectrum of a Single Electron**” (Paper ID:48 submitted to **International Conference on Advances in Engineering, Architecture, Science and Technology (ICA-EAST 2021)**) has been evaluated utilizing a two-person referee process and upon their recommendation your paper has been accepted for **Online** presentation and publication.

Please visit our web site for presentation guidelines and detailed information. We thank you for your contribution to ICA-EAST 2021 and expect meeting you in Erzurum Technical University Erzurum/Turkey during 15-17 December 2021.

For more information on the congress, please check the ICA-EAST 2021 web site at:

<https://ica-east.erzurum.edu.tr/>

Sincerely,

Prof. Dr. Ali Fatih YETİM

GENERAL CHAIR

Assoc. Prof. Dr. Salih AKPINAR

CONFERENCE CHAIR

# Effect of Ultrashort Laser Pulse Shape on the Dipole Spectrum of a Single Electron

Muhammed Sayrac <sup>1\*</sup>[0000-0003-4373-6897]

<sup>1</sup>muhammedsayrac@cumhuriyet.edu.tr, Department of Nanotechnology Engineering, Sivas Cumhuriyet University, Sivas, Turkey

## Abstract

In this study, the effects of ultrashort laser pulse shape for the laser-matter interaction have been considered. Three different pulse shapes, Gaussian, Super-Gaussian, and Cosine-Squared, are used to calculate the dipole spectrum of the single atom by considering the Lewenstein model. The ultrashort laser pulse shapes are presented, and it has been found that the super-Gaussian laser pulse, which has a spiky and strong tail, has been more effective in transferring energy to the electron. The electron is excited and gains kinetic energy under the ultrashort laser pulse. The laser pulse-electron interaction affects the ground state wave function and the returning electron wave packet. The optimum dipole spectrum, which is extended to higher photon energies, has been obtained under the Super-Gaussian pulse shape.

**Keywords.** Ultrashort Pulse shapes, Intense Laser Field, Electron Dipole Spectrum, Gaussian, Electron Propagation

## 1. Introduction

Laser-matter interaction brings out the nonlinear phenomena. Electron propagation under the intense and short laser pulse has been the subject of great interest for experimental and theoretical research. Attempts have been made to achieve ultrahigh technological devices using high-intensity ultrashort laser pulses [1]. The ionized electron wave packet is controlled by the driving laser field. The dipole spectrum of a single atom is evaluated by the electric field of the driving pulse.

The spectral distribution of an electron depends on several parameters, namely the ionization potential of the target atom, driving laser wavelength, the intensity of the laser field, and the pulse shape. These parameters steer the electron during the propagation. The electron accelerated under the laser field, and gain kinetic energy. Then, the electron recombines with the parent atom, and the emission of its gained energy is released.

In this paper, the dipole spectrum of a single electron is obtained for different pulse shapes by using the Lewenstein model. An ultrashort laser pulse excites the electron to gain energy that directly affects the interference of the ground state wave function and the returning electron wave packet. The paper is organized as follows. Section 2 gives the expression of the pulse shapes and the dipole moment. Section 3 is devoted to the simulation results where the effects of laser pulse shapes and dipole spectrum are examined. Finally, the summary of the whole analysis is presented in the last section.

## 2. Theory

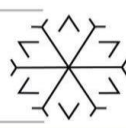
In this study, we consider different pulse shapes to obtain the dipole spectrum of a single atom. The pulse shapes are assumed to be an ultrashort pulse, and the spectrum is broad. Gaussian pulse shape, Super-Gaussian pulse shape, and Cosine-squared pulse shape are used as a driving field to compute the dipole spectrum of a single electron. The pulse envelope for the pulse shape is given below [2].

$$E \approx e^{-(t/\tau)^2} \rightarrow \text{Gaussian}$$

$$E \approx e^{-(t/\tau)^4} \rightarrow \text{Super - Gaussian}$$

$$E \approx \text{Cos}\left(\frac{t}{\tau}\right)^2 \rightarrow \text{Cosine - Squared}$$

here  $t$  is the time axis in atomic units, and  $\tau$  is the full width at half-maximum (FWHM) pulse duration. In the case of the driving field being an ultrashort pulse, the driving field has many frequency components, i.e. the spectrum is broad.

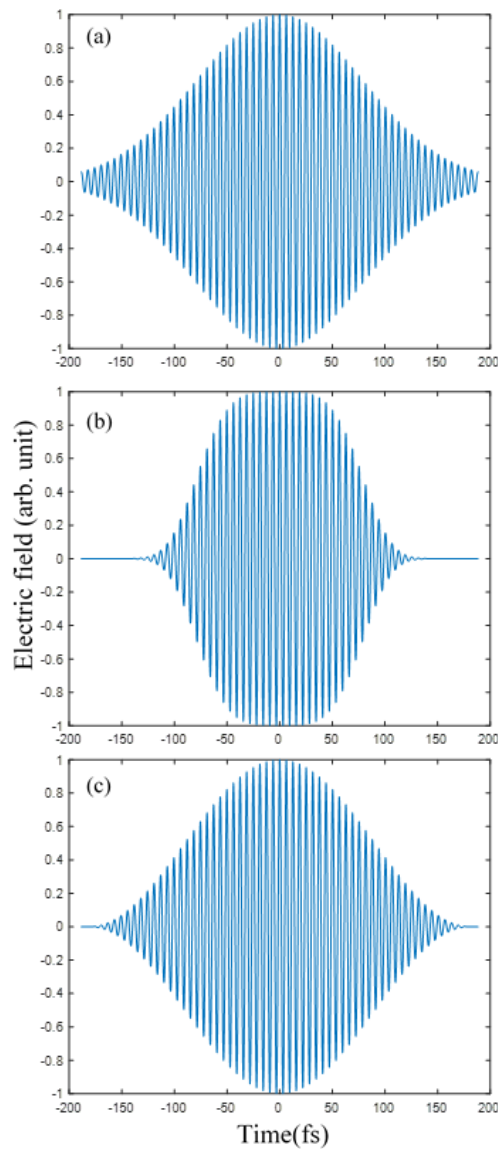


The Gaussian pulse shape is described with a Gaussian function. On the other hand, the Super-Gaussian pulse shape has a spiky appearance with heavy tails. The Cosine-Squared pulse is the square of the cosine function. The pulse shapes simulated by using Eq. 1 are presented in Fig. 1.

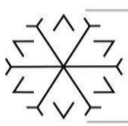
By considering the different pulse shapes, the Single Atom Dipole Response of an electron is simulated by using the Lewenstein method [3]. The dipole moment is given in Ref. [4].

$$d(t) = -ie_x \int_0^\infty d\tau \left( \frac{\pi}{\varepsilon + i\tau/2} \right)^{3/2} E \cos(t - \tau) D_x(p_s(t, \tau) - A_x(t - \tau)) \times \exp(-iS_s(t, \tau)) D_x^*(p_s(t, \tau) - A_x(t)) + c.c.$$

where the probability amplitude for the driving field is  $D_x^*(p_s(t, \tau) - A_x(t))$ . A coupling the ground state to the vacuum continuum state is  $D_x(p_s(t, \tau) - A_x(t - \tau))$ . The phase of the electron acquired during propagation is  $\exp(-iS_s(t, \tau))$ .  $S_s$  is the quasiclassical action corresponding to the electron trajectory [5].



**Figure 1:** The simulated driving pulse shapes of (a) Gaussian, (b) Super-Gaussian, and (c) Cosine-Squared.



### 3. Results

The dipole response of a single atom is simulated by considering different driving pulse shapes with 70fs FWHM pulse duration, the central wavelength of 1000nm, and the intensity of  $10^{14}\text{W}/\text{cm}^2$ . The simulated driving pulse shapes are presented in Fig. 1.

For the different driving pulse shape described in Eq. 1, the dipole spectrum of a single atom is calculated by considering the contribution of short and long electron trajectories. Most of the laser field is considered to have Gaussian distribution. The dipole spectrum is simulated for each described pulse shape presented in Fig.1. The frequency conversion of the initial driving radiation of 1000nm (corresponding photon energy of 1.24eV) is achieved up to about 80eV photon energy (corresponding wavelength of about 15nm). Figure 2 is for the simulation results taking into account the Gaussian pulse shape, where the extension of the radiation up to 75eV is obtained.

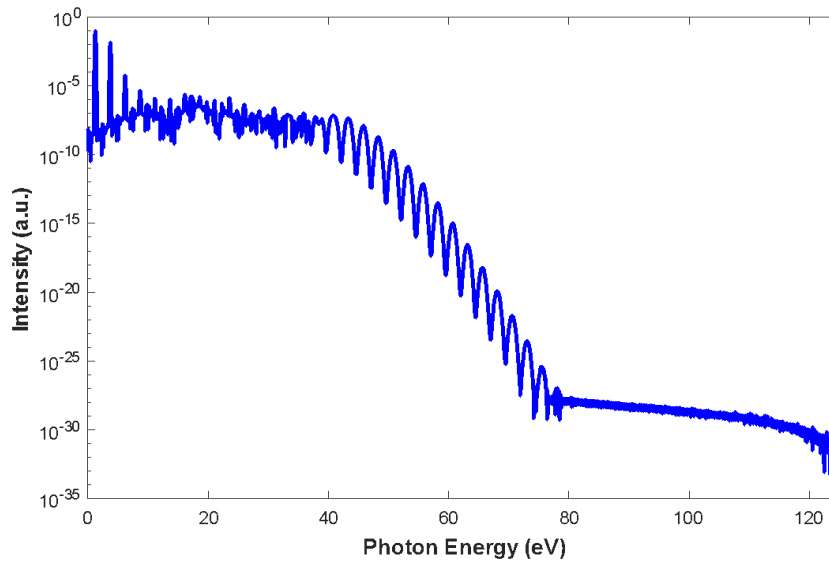


Figure 2: The electron dipole spectrum by using Gaussian pulse shape.

Moreover, the Super-Gaussian pulse shape has stronger wings compared to the Gaussian pulse, Fig. 1. The electron dipole spectrum under the super-Gaussian pulse shape is simulated, and the generated photon energy up to  $>80\text{eV}$  is well resolved. The reason for the high photon energy is because of the strong spiky peak and strong wing of the Super Gaussian pulse shape.

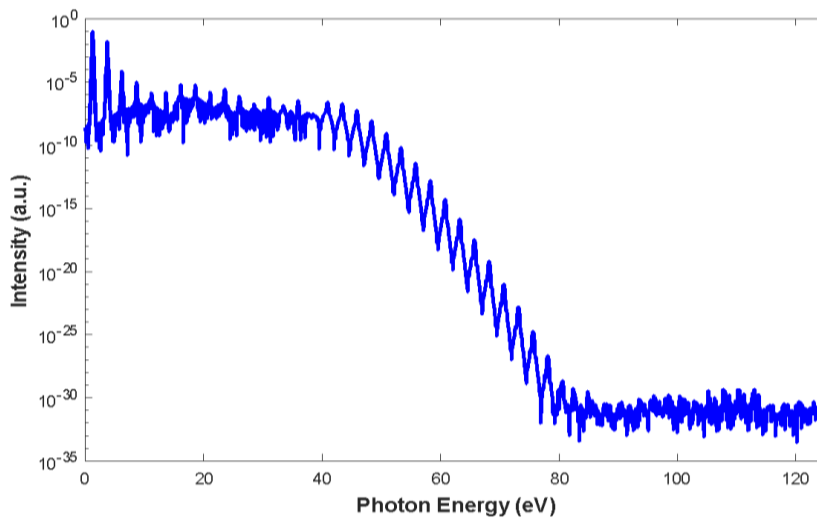
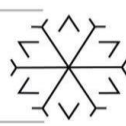
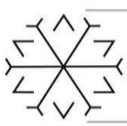
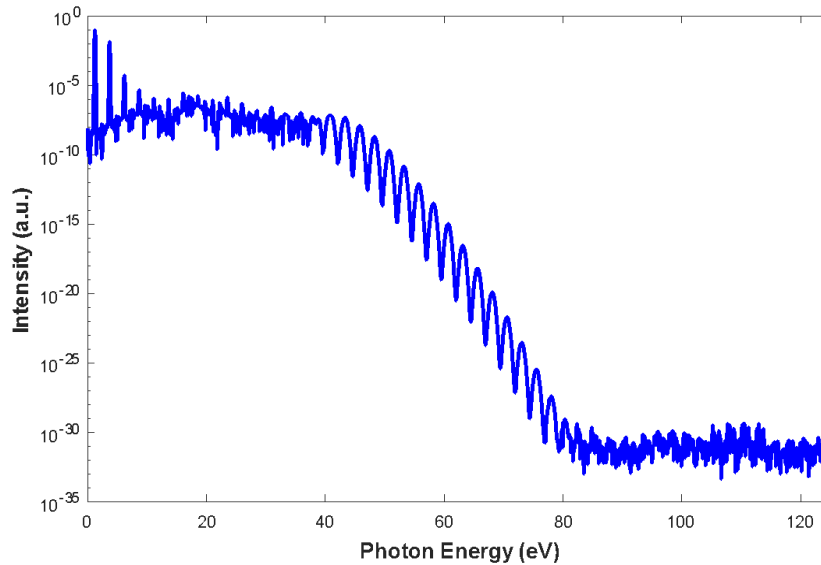


Figure 3: The electron dipole spectrum by using a Super-Gaussian pulse shape.



Finally, the Cosine-Squared pulse shape distribution is used for the simulation input parameter. The square term brings a slightly strong tail on the Cosine-Squared pulse shape. The calculated dipole spectrum up to 80eV photon energy is achieved in Fig. 4.

Overall, the photon energy of the generated radiation due to electron-laser interaction is obtained in an energy range from 75eV to >80eV, which is comparable to the photon energy of the fundamental field. The frequency conversion is significant for producing optical pulses with high photon energy for practical applications, which require high spatial and temporal resolution.



**Figure 4:** The electron dipole spectrum by using Cosine-Squared pulse shape.

#### 4. Conclusion

In this work, the different pulse shape is considered for obtaining dipole spectrum, which gives the emitted radiation after the laser-matter interaction. The laser-matter interaction results in electron ionization and propagation under the effect of the laser field. The shape of the laser field directly affects the propagation of the free electron in the continuum.

Overall, the electron trajectories after the ionization are mainly affected by the driving laser field. The shape of the pulse controls the electron excursion time and results in different spectral distributions. The sharpness and strong wings of the pulse shape accelerate the electron, and the electron gains more kinetic energy. This results in the strong recombination, i.e. overlapping ground state wave function with the returning electron wave packet.

The simulation study can be useful for pre-experimental studies to determine how ultrashort pulse shape affects the electron behavior under the intense laser field, i.e. propagation, ionization, and recombination of an electron, or interference of electron wave packet with the ground-state electron wave packet.

#### References

- [1] M. Fouladi, H. Akou, "Effect of ultrafast laser pulse shape on the electron-plane wave interaction in vacuum," *JOSA B*, 36 603-609, 2019.
- [2] R.P. Encyclopedia, Gaussain Pulses - *RP Photonics Encyclopedia*, 2021.
- [3] M. Lewenstein, P. Balcou, M.Y. Ivanov, A. L'Huillier, P.B. Corkum, "Theory of high-harmonic generation by low-frequency laser fields," *Phys. Rev. A*, 49 2117-2132, 1994.
- [4] P. Antoine, A. L'Huillier, M. Lewenstein, P. Salières, B. Carré, "Theory of high-order harmonic generation by an elliptically polarized laser field," *Phys. Rev. A*, 53 1725-1745, 1996.
- [5] S. Bhardwaj, "Limits of Long Wavelength High Harmonic Generation," Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Department of Electrical Engineering, and Computer Science., 2010.



ERZURUM TECHNICAL UNIVERSITY

2010

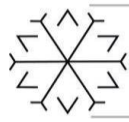
FACULTY of ENGINEERING and ARCHITECTURE

**International Conference on Advances in  
Engineering, Architecture,  
Science and Technology  
(ICA-EAST 2021)**

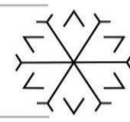
**December 15-17, 2021  
in Erzurum, Turkey**

**PROCEEDINGS  
BOOK**

ISBN: 978-605-74839-1-1



ICAEAST'21



# 1<sup>st</sup> INTERNATIONAL CONFERENCE ON ADVANCES IN ENGINEERING, ARCHITECTURE, SCIENCE AND TECHNOLOGY

DECEMBER 15-17, 2021 in Erzurum, TURKEY

## Organizer of the Conference

Faculty of Engineering and Architecture at Erzurum Technical University

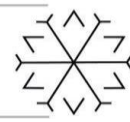
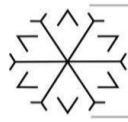
## Editors

Prof. Dr. Ali Fatih YETİM

Assoc. Prof. Dr. Salih AKPINAR

Res. Asst. Uğur KILIÇ





## HONORARY CONFERENCE CHAIR

Prof. Dr. Bülent ÇAKMAK

## GENERAL CHAIR

Prof. Dr. Ali Fatih YETİM

## CONFERENCE CHAIR

Assoc. Prof. Dr. Salih AKPINAR

## ORGANIZING COMMITTEE

Assoc. Prof. Dr. Nur Hüseyin KAPLAN

Assoc. Prof. Dr. Muhammed Yasin ÇODUR

Assoc. Prof. Dr. Mahyar MAALI

Assoc. Prof. Dr. Tuba YETİM

Asst. Prof. Dr. Türkay KOTAN

Asst. Prof. Dr. İbrahim ATES

Asst. Prof. Dr. Onur ÇOMAKLI

Asst. Prof. Dr. Burak Kaan ÇIRPICI

Asst. Prof. Dr. Çağlar DUMAN

Asst. Prof. Dr. Merve YILDIRIM

Asst. Prof. Dr. Yaşar DAŞDEMİR

Asst. Prof. Dr. Mahmut TUTAM

Asst. Prof. Dr. Merve KAYACI ÇODUR

Asst. Prof. Dr. Ömer Halil ÇAVUŞOĞLU

Asst. Prof. Dr. Işıl KARABEY AKSAKALLI

Dr. Rumeysa BAYAR

Dr. Çağrı ULUDÜZ

Res. Asst. Emre MANDEV

Res. Asst. Resul ŞAHİN

Res. Asst. Burak GEDİK

Res. Asst. Kadir Diler ALEMDAR

Res. Asst. Yasin Demir

Res. Asst. Ali Kıvanç Şahin

Res. Asst. Ömer Faruk Yıldırım

Res. Asst. Nadide ÇAĞLAYAN

Res. Asst. Ömer Faruk ÇAPAROĞLU

Res. Asst. Elif AYIK

Res. Asst. Güven Balta

Res. Asst. Şeyma KOCADAĞIŞTAN

Res. Asst. Yelda Gamze YALÇINER

Res. Asst. Uğur KILIÇ

## SECRETARY

Res. Asst. Yasin Demir

Res. Asst. Elif AYIK

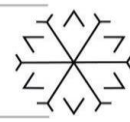
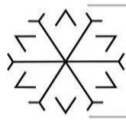
Res. Asst. Ömer Faruk ÇAPAROĞLU

Res. Asst. Yelda Gamze YALÇINER

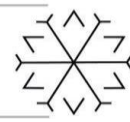
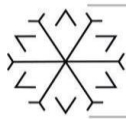
## SCIENTIFIC COMMITTEE

Prof. Dr. İrfan KAYMAZ, Erzurum Technical University

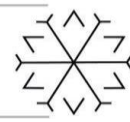
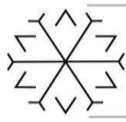
Prof. Dr. Birol SOYSAL, Erzurum Technical University



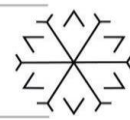
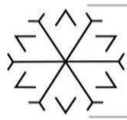
Prof. Dr. Mehmet Akif CEVİZ, Erzurum Technical University
Prof. Dr. Abdulkadir Cüneyt AYDIN, Atatürk University
Prof. Dr. Adnan DERDİYOK, Sakarya University
Prof. Dr. Ahmet Ferhat BİNGÖL, Atatürk University
Prof. Dr. Alaeddin ARPACI, İstanbul Technical University
Prof. Dr. Andrey Ronzhin
Prof. Dr. Ayhan ÇELİK, Atatürk University
Prof. Dr. Bedir TEKİNERDOĞAN, Wageningen University
Prof. Dr. Olja Cokorilo, University of Belgrade
Prof. Dr. Bülent ÇAVUŞOĞLU, Atatürk University
Prof. Dr. Cafer ÇELİK, Atatürk University
Prof. Dr. Hakan GÖKDAĞ, Bursa Technical University
Prof. Dr. Halil İbrahim Okumuş, Karadeniz Technical University
Prof. Dr. Handan Türkoğlu, İstanbul Technical University
Prof. Dr. Hossein Showkati, Urmia University
Prof. Dr. İhsan EFEOĞLU, Atatürk University
Prof. Dr. İnci Deniz Ilgın
Prof. Dr. İrfan KARAGÖZ, Uludağ University
Prof. Dr. İrfan KURTBAŞ, Hitit University
Prof. Dr. İsmail Hakkı ALTAŞ, Karadeniz Technical University
Prof. Dr. İsmail Hakkı Çavdar, Karadeniz Technical University
Prof. Dr. Jasmina Pašagić Škrinjar, University of Zagreb
Prof. Dr. Masoud Hajjalilue Bonab, University of Tabriz
Prof. Dr. Mehmet ERTUĞRUL, Atatürk University
Prof. Dr. Mehmet Hamit ÖZYAZICIOĞLU, Atatürk University
Prof. Dr. Mehmet İhsan KARAMANGİL, Uludağ University
Prof. Dr. Mehmet Önder EFE, Hacettepe University
Prof. Dr. Meltem Eti Proto, Sapienza University of Rome & Rome University of Fine Arts
Prof. Dr. Murat Ekinci, Karadeniz Technical University
Prof. Dr. Mustafa AKTAŞ, Ondokuz Mayıs University
Prof. Dr. Ömer Delialioğlu, Middle East Technical University
Prof. Dr. Ömer GÜNDOĞDU, Atatürk University
Prof. Dr. Ratko Đuričić, University of East Sarajevo
Prof. Dr. Salim KAHVECİ, Karadeniz Technical University
Prof. Dr. Serpil EROL, Gazi University
Prof. Dr. Suat ÖZDEMİR, Hacettepe University
Prof. Dr. Süleyman TOSUN, Hacettepe University
Prof. Dr. Şeref Sağıroğlu, Gazi University
Prof. Dr. Temel Kayıkçıoğlu, Karadeniz Technical University
Prof. Dr. Tevhit KARACALI, Atatürk University
Prof. Dr. Turgay Tugay BİLGİN, Bursa Technical University
Prof. Dr. Yong C. WANG, University of Manchester
Prof. Dr. Mehmet Çopur, Bursa Technical University
Prof. Dr. Osman Nuri Şara, Bursa Technical University
Prof. Dr. Ömer Laçın, Atatürk University
Prof. Dr. Özlem Korkut, Atatürk University



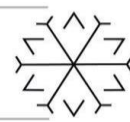
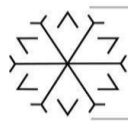
Prof.Dr. Sinan Yapıcı, Malatya İnönü University
Prof. Dr. Kadir TÜRK, Karadeniz Technical University
Assoc. Prof. Dr. Nur Hüseyin KAPLAN, Erzurum Technical University
Assoc. Prof. Dr. Ahmet DUMLU, Erzurum Technical University
Assoc. Prof. Dr. Kağan Koray AYTEN, Erzurum Technical University
Assoc. Prof. Dr. Tuba YETİM, Erzurum Technical University
Assoc. Prof. Dr. Fatih TOSUNOĞLU, Erzurum Technical University
Assoc. Prof. Dr. Ahmet Burak CAN, Hacettepe University
Assoc. Prof. Dr. Aleksandar Stevanovic, University of Pittsburgh
Assoc. Prof. Dr. Aleksandra BOGDANOVIC, Ss. Cyril and Methodius University
Assoc. Prof. Dr. Ali İnan, Adana Alparslan Turkes Science and Technology University
Assoc. Prof. Dr. Ali Sinan Dike, Adana Alparslan Turkes Science and Technology University
Assoc. Prof. Dr. Barış ERDİL, Van Yüzüncü Yıl University
Assoc. Prof. Dr. Borna Abramovic, University of Zagreb
Assoc. Prof. Dr. Burak Erkayman, Atatürk University
Assoc. Prof. Dr. Fatma Zehra ÇAKICI, Atatürk University
Assoc. Prof. Dr. Danielle Sinnet, University of West of England
Assoc. Prof. Dr. Elif Kılıç Delice, Atatürk University
Assoc. Prof. Dr. Emre Özkop, Karadeniz Technical University
Assoc. Prof. Dr. Emre ÖZYURT, Gümüşhane University
Assoc. Prof. Dr. Fatih KABURCUK, Sivas Cumhuriyet University
Assoc. Prof. Dr. Fatih Mehmet ÖZKAL, Atatürk University
Assoc. Prof. Dr. H. Tonguç Tokol, Marmara University
Assoc. Prof. Dr. Hacı Süleyman GÖKÇE, Bayburt University
Assoc. Prof. Dr. İbrahim Yücel ÖZBEK, Atatürk University
Assoc. Prof. Dr. İlhan ÇELİK, Samsun University
Assoc. Prof. Dr. İlker TEKİN, Karabük University
Assoc. Prof. Dr. Jülide Erkmén, Kars Kafkas University
Assoc. Prof. Dr. Marinko Maslarić, University of Novi Sad
Assoc. Prof. Dr. Marko Subotić, University of East Sarajevo
Assoc. Prof. Dr. Marta STOJMANOVSKA, Ss. Cyril and Methodius University
Assoc. Prof. Dr. Mehmet Emin Erendor, Türkiye Manas University
Assoc. Prof. Dr. Momcilo Dobrodolac, University of Belgrade
Assoc. Prof. Dr. Murat Beken, Bolu İzzet Baysal University
Assoc. Prof. Dr. Musa ARTAR, Bayburt University
Assoc. Prof. Dr. Mustafa YILMAZ, Atatürk University
Assoc. Prof. Dr. Muteber Erbay, Karadeniz Technical University
Assoc. Prof. Dr. Müge Göker Paktaş, Marmara University
Assoc. Prof. Dr. Neslihan Alemdar, Marmara University
Assoc. Prof. Dr. Önder Aydemir, Karadeniz Technical University
Assoc. Prof. Dr. Özge Kerkez Kuyumcu, Marmara University
Assoc. Prof. Dr. Ramazan ÖZÇELİK, Akdeniz University
Assoc. Prof. Dr. Sabri BIÇAKÇI, Balıkesir University
Assoc. Prof. Dr. Serdar SELAMET, Bogazici University
Assoc. Prof. Dr. Serkan ŞENOCAK, Atatürk University
Assoc. Prof. Dr. Sevil Şen Akagündüz, Hacettepe University



Assoc. Prof. Dr. Temel VAROL, Karadeniz Technical University
Assoc. Prof. Dr. Tuğrul Çavdar, Karadeniz Technical University
Assoc. Prof. Dr. Aslı ÇEKMIŞ KANAN, İstanbul Teknik Üniversitesi
Assoc. Prof. Dr. Can UZUN, Altınbaş Üniversitesi
Assoc. Prof. Dr. Gökçe HACIOĞLU, Karadeniz Teknik Üniversitesi
Asst. Prof. Dr. Ali Ünlütürk, Erzurum Technical University
Asst. Prof. Dr. Babak KARIMI, Erzurum Technical University
Asst. Prof. Dr. Hilal KOÇ POLAT, Erzurum Technical University
Asst. Prof. Dr. Mahmut TUTAM, Erzurum Technical University
Asst. Prof. Dr. Merve KAYACI ÇODUR, Erzurum Technical University
Asst. Prof. Dr. Merve YILDIRIM, Erzurum Technical University
Asst. Prof. Dr. Mete ÖZBALTAN, Erzurum Technical University
Asst. Prof. Dr. Ömer Halil ÇAVUŞOĞLU, Erzurum Technical University
Asst. Prof. Dr. Turgay DUMAN, Erzurum Technical University
Asst. Prof. Dr. Saffet Gökçen ŞEN
Asst. Prof. Dr. Meltem GÖR BÖLEN
Asst. Prof. Dr. Adil YÜCEL, İstanbul Technical University
Asst. Prof. Dr. Ahmed Riedh Al-Hamaoy, Al-Nahrain University
Asst. Prof. Dr. ALİ CELEN, Erzincan University
Asst. Prof. Dr. Atinc Yılmaz, Beykent University
Asst. Prof. Dr. Aylin Aras, Bursa Technical University
Asst. Prof. Dr. Serkan Sipahi, Atatürk University
Asst. Prof. Dr. Dimitrios Tsolis, University of Patras
Asst. Prof. Dr. Elif Özmetin, Balıkesir University
Asst. Prof. Dr. Erbil Kavcı, Kars Kafkas University
Asst. Prof. Dr. Erdal ÖNER, Bayburt University
Asst. Prof. Dr. Erdem Aksakal, Atatürk University
Asst. Prof. Dr. Fuat AKAL, Hacettepe University
Asst. Prof. Dr. Furat Ibrahim Hussein, University of Baghdad
Asst. Prof. Dr. Hamid Yılmaz, Bayburt University
Asst. Prof. Dr. M. Fatih ÇORAPSIZ, Atatürk University
Asst. Prof. Dr. Marina Zanne, University of Ljubljana
Asst. Prof. Dr. MEHRZAD MOHABBI, Bingöl University
Asst. Prof. Dr. Mohammad Ali Sahraei, Girne American University
Asst. Prof. Dr. Pelin ANGIN, Middle East Technical University
Asst. Prof. Dr. Tuba Eroğlu AZAK, Milli Savunma University
Asst. Prof. Dr. Tuba Sarı, Bursa Technical University
Asst. Prof. Dr. Yaşar Andelip Erdoğan, Marmara University
Asst. Prof. Dr. Yeşim OK, Atatürk University
Asst. Prof. Dr. Željko Stević, University of East Sarajevo
Asst. Prof. Dr. Željko Stević, University of East Sarajevo
Asst. Prof. Dr. Zeynep Neşe KURT ALBAYRAK, Atatürk University
Asst. Prof. Dr. Işıl KARABEY AKSAKALLI, Erzurum Technical University
Dr. Çağrı ULUDÜZ, Erzurum Technical University
Dr. Rumeysa BAYAR, Erzurum Technical University
Dr. Abbas Al-Refai, The University of Jordan

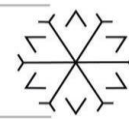
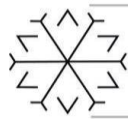


Dr. Abdolhossein Naghizadeh, University of Free State
Dr. Ammar Al-Bazi, Coventry University
Dr. Anton Saveliev
Dr. Dario Babic, University of Zagreb
Dr. Felix Okonta, University of Johannesburg
Dr. Haitao Liao, University of Arkansas
Dr. Ian Mackie, University of Sussex
Dr. Jingming Liu, Hebei University of Technology
Dr. Liliana Delgado Hidalgo, Universidad del Valle
Dr. Mohammad A. Shbool, The University of Jordan
Dr. Ondrej Stopka, Institute of Technology and Business
Dr. Rahim Dehkharghani, University of Bonab
Dr. Rouzbeh DABIRI, Islamic Azad University of Tabriz
Dr. Tone Lerher, University of Maribor
Dr. Orkan Zeynel GÜZELCİ, University of Porto
Dr. Mehmet Hakan DURAK, Erzurum Technical University
Dr. Volkan KIZILOĞLU, Erzurum Technical University

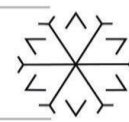
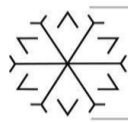


## CONTENTS

Smoother Sliding Mode Tracking Control of Quadrotor UAV by Using Saturation Function .....	1
Design and Control of One-DOF Helicopter System .....	10
Predicting the Result of Penalty Kick using Statistical and Match Day Features .....	15
Advanced Cyberbullying Identification with Bidirectional Encoder Representations from Transformers .....	22
Design and Simulation of Soft-Switched PWM Full-Bridge DC-DC Converter with Snubber Cell and No Additional Control .....	23
An Advanced Visible Light Communication Technique: Li-Fi (Light Fidelity) .....	32
ECC Implementation on FPGA with Fast and Pipelined Arithmetic Units .....	39
Development of a Fuzzy Logic Based Control Algorithm for Charge-Discharge of a Battery System .....	48
Epileptic Seizure Detection Based on EEG Data Using Discrete Wavelet Transform .....	57
LED Selection Algorithm for Indoor Li-Fi Systems .....	63
Characterization of ZnO Thin Films Deposited by SILAR and Spin Coating Methods .....	70
Investigation of Multisection Mode Locked 980 nm and 1550 nm Diode Lasers .....	75
Mathematical Analysis and Control of Six Degrees of Freedom Flight Simulators .....	82
Design and Implementation of Band Pass Filter based PI Controlled Shunt Active Power Filter to Fulfill IEEE-519 Harmonic Distortion Limits.....	90
Effect of Ultrashort Laser Pulse Shape on the Dipole Spectrum of a Single Electron.....	97
Mel-Spectrograms and Data Augmentation for Spoken Digit Classification .....	101
Comparison of Cognitive Workload and Resting States in Different Brain Lobes and EEG Frequency Bands .....	109
Performance Comparison of IEEE 802.11p Wave and IEEE 802.11 MAC Protocols Based on AODV Routing Protocol.....	119
Calculation of Electric Motor Values for Wind Turbines Electromagnetic Field Effect .....	125
Single Phase 5-Level NPC Multilevel Inverter Using Level-Shifted Sinusoidal PWM .....	130
A Software Based Simulation for Adaptive Optics System of Eastern Anatolia Observatory.....	138
Causal Learning versus Machine Learning .....	142
Three-Dimensional Modelling and Simulation of Porous silicon based PEM Fuel Cells using COMSOL Multiphysics .....	143
Investigation of Factors Affecting Radar Systems with Fuzzy Logic Method .....	144
Design of Flexible Antennas for Mobile Communication and 5G Application .....	150
Resource Allocation in Non-Orthogonal Multiple Access .....	154
A Decision Based Fusion Method for Brain Lesion Images .....	161
Design and Comparison of MPPT Under Shading Conditions With Different Algorithms for Photovoltaic Systems .....	163
A High Directivity 2.8GHz Microstrip Directional Coupler Design by using Grey Wolf Optimizer for Radio Telescope Systems .....	169
Nonlinear Controller Design of DC-DC Buck Converter and Real Time Application .....	170
A Performance Metric Proposal to Evaluate Effectiveness of Demand Side Management in Smart Grids .....	179
Effects of Grid Integration of Electric Vehicles and Charging Stations .....	180
Printed Circuit Board Surface Defect Detection using YOLOv4 algorithm.....	181
Analyzing Pattern for Huge Databases .....	189
Investigation of The Initialization Contour Effect In The Chan-Vese Method.....	195
IoT Enabled Technologies: Associated Issues and Challenges .....	201
Comparison of Copy-Move Image Forgery Detection Techniques .....	210
A Study on Detection of Forest Fire .....	219
Creating Cloud GIS Based Geographical Indication Tourism Web and Mobile Apps .....	223
A Novel Most Probable Path Computation of Stochastic Hidden Systems with Updated Parameters by using a 1-Step Optimization Discrete Control Algorithm .....	228
Covid-19 Detection with Deep Learning Methods from X-Ray Images .....	229
Can Machines Talk? Turkish Voice Assistant and Chatbot Design with Artificial Intelligence in Erzurum Technical University .....	230
Sentiment analysis in Persian using discourse and external semantic information.....	237
BCI-based Game Design Promoting Our Cultural Heritage.....	245
Voice Spoofing Countermeasure to Detect Replay Attacks Using Spectral Features and BiLSTM .....	246
An Overview of Ransomware Attacks and Mitigation Techniques.....	254

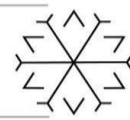
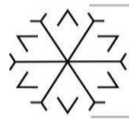


Deep Computerized System for Lung Based Diagnostic Problems In Ct Scans.....	260
A Performance Monitoring System with the Capability of Detecting Anomalies for Corporate Business Intelligence Reporting Systems...	261
Sentiment Analysis of Turkish Tweets on Covid-19 Using Word Embedding vectors and Bidirectional Long Short Term Memory Networks .....	270
Recognition of Electronic Circuit Components Using a Modern Convolutional Object Detector.....	271
Detection of Distributed Denial of Service (DDoS) Attacks with Machine Learning Methods .....	279
Wi-Fi Fingerprint-based Indoor Localization in Different Environments .....	280
Using Deep Learning Models for Classification Hyperspectral Data .....	281
A New Mathematical Model for Private Car Sharing .....	282
Two-Step Method Based on Local Search for Two-Dimensional Two-stage Cutting Stock Problem.....	283
A Discrete Differential Evolution Algorithm for Unidirectional Loop Layout Problem .....	291
Improving Warehouse Operations by Radio Frequency Identification (RFID) Technology .....	292
Prediction of COVID-19 Death Rates with Artificial Neural Network Under Different Time Series Models Based on Moving Averages ...	303
The Method of Modulated Fourier Series Expansion Applied to Hourly Electricity Consumption .....	310
Jetty Optimization and An Application.....	318
Review On: Construction Waste Minimization by Adopting Different Techniques .....	319
Types Of Construction Waste, Their Contributions To The economy And Sustainability Of The Project.....	326
Modeling of COVID-19 Pandemic with Artificial Neural Network: A Case Study for Turkey and the USA.....	333
Effect of Elastic Foundation on The Vibration of Non-Homogeneous Orthotropic Shell Geometry.....	334
Deep Learning Based Intelligent Traffic Volume Measurement.....	343
Parametric Analysis of a Box Girder Highway Bridge for Different Lead Rubber Bearing Properties Using API .....	350
The Influence of The Horizontal Friction on The Internal Forces of The Slab on Ground Affected by Shrinkage .....	359
Impacts Of Climate Change On Water Resources Of Turkey .....	366
X-Ray Impermeability of Concretes Containing Celestite Aggregate Produced With Calcium Aluminate Cement .....	373
Effect of Low Content of Hemp Fibre on Flexural Behavior of Mortar.....	379
Leveraging Clean and Advanced Technologies to Increase Health System Resilience in Conflict Areas .....	384
Dynamic Analysis of a Framed Machine Foundation with Vibration Isolation Materials.....	385
Some Mechanical Properties of Polymer Modified Concrete .....	386
Effect of Antifreeze Additives on The Properties of Mortars Containing Silica Fume Exposed to Frost in Fresh State .....	394
Optimization of urban bus stops for increasing the use of public transportation .....	405
Ultimate Drift Ratio Limit of Steel Plate Shear Walls .....	415
Numerical Analysis of the Impact of Polypropylene Fiber on the Shear Strength of Hollow-Core Slabs.....	423
Experimental Behaviour of Screw Beam-to-Column Connections in Cold-Formed Steel Under Cyclic Loading - A review .....	334
Geopolymers in Soil Stabilization from Past to Present.....	443
Modal Analysis of Industrial Steel Stacks with Soil-Structure Interaction.....	448
Numerical Investigation of the Solute Dispersion Phenomenon Based on the Advection-Diffusion Equation.....	449
The Effect of Using Various Reinforcement Mesh on Fire Performance of Composite Flooring System.....	455
Clays and Polymer/Clay Nanocomposites and Their Application in Engineering.....	464
Experimental Behaviour of Screw Beam-to-Column Connections in Cold-Formed Steel Under Cyclic Loading - A review .....	470
Sustainable Aviation Fuels: Policy and Production.....	478
Carbon Negative Buildings.....	479
Workability of Concrete Having Hybrid Natural Fibers of Different Lengths for Easy Pouring.....	483
Review On Potential Of Waste Materials As Fire-Resistant Materials .....	489
Potential Of Used-Diesel-Engine-Oil As An Admixture In Cement Composites: A Detailed Review .....	497
An Overview on Different Corrugated Sheets from Manufacturing to Housing Element .....	503
Determination of Changes in Precipitation and Snowpack Using Innovative Trend Analysis in Sinirbaşı Basin .....	508
Numerical Analysis of Embankment Slopes Reinforced by Different Methods Using Plaxis 2D Program .....	509
The Examination of The Effect Of Rock Salt On The Setting Time Of The Grout By Utilizing The Taguchi Method .....	510
Evaluation of The Importance of Geomorphic Indices on River Basins Located on Different Slopes, Case Study: Sivas Province, Koyulhisar, Turkey .....	511



A View of Historic Structures Survived in 1859 Erzurum Earthquake .....	520
An Application of Cold Weather Concreting in Erzurum .....	521
Titanium-Zinc as an Architectural Material: ETU Campus Gate Project .....	522
A Model for Visualization of Customer’s Attention That Occurs on the Furniture by Using Eye-Tracking Technology and Determination Its Effect on New Product Design.....	531
Erzurum Surp Minas Church .....	537
Evaluation of the Components of Design Thinking in Terms of Design Education .....	543
Understanding the Meanings of Sustainability: Historical Roots, Current Perspectives, Future Directions .....	549
Rural Studies in A Disaster Region – Obruk Plateau .....	556
Urban Regeneration: Construction of Factor model.....	562
Using Digital Technology in Architectural Design Education and Its Effect on Creativity .....	571
Impact of Climate Change on Building Energy Consumption .....	572
Study on Adsorption Performance of MIL-101 (Cr) for Ibuprofen Uptake from Aqueous Media .....	577
Mechanochemical Synthesis and Characterization of Mn-B Phases .....	578
Investigation of Photocatalytic Activity of Calcium Aluminate Spinel Ceramics Synthesized by Microwave Assisted Combustion Method.....	579
Cannabis Production And State Policy In Turkey .....	585
Bio-Catalytic Conversion of CO2 to Solid Carbonate.....	592
Determination of Geographical Origin in Alcoholic Beverages Using Vibrational Spectroscopy and Chemometrics .....	593
Determination of some quality parameters of cheese by portable FT-NIR combined with PLSR.....	594
Investigation Of Properties Of Renewable Films Prepared With Aloe Vera Gel .....	595
An Experimental and Simulation Analysis of A Single-Cylinder Diesel Engine Fuelled by C2 Alcohol and Nano-Sized Materials .....	596
Comparison of Experimental and Simulation Results for Alcohol and Nanofuels in CI Engines .....	606
Frameless PMSM Position Control in Pan-Tilt System with 2-Axes .....	616
Investigation of Tribological Properties of Ultra High Molecular Weight Polyethylene (UHMWPE) Bearings.....	625
Design and development of an industrial conveyor line with computerized control .....	633
Tuned gyrostabilizer for control of vibrations in Two-wheeled Robot.....	634
Energy and carbon dioxide savings analysis for a single-family dwelling in Muğla region.....	635
Synthesis and Characterization of Magnetic Metal Organic Framework (MOF) for Methyl Orange Removal from Aqueous Solutions .....	642
Parametric Analysis of Photovoltaic Module.....	643
Numerical Analyses Of The Effect Of Reflector Emissivity At Radiant Tube Heaters.....	651
Quantification of hemodynamic parameters of fetal hearts using computational fluid dynamics.....	652
Development of An Image Processing Tool for IVUS Images-Based Patient-Specific CFD Simulations .....	653
Long-Term Stability Analysis of Surface-Modified Nanofluids .....	654
Numerical Analysis on Spiral Heat Exchanger; Effects of Using Nanofluid and Ball Turbulators .....	655
Conformity in Theoretical and Experimental Analyses, Performance of Heat pumps .....	656
Investigation of The Static Strength of Porcelain Fused to Metal Dental Crowns with Surface Protrusions Produced by Selective Laser Melting by Finite Element .....	657
Studies on Adhesivly Bonded Layers under cyclic loading .....	658
An Experimental Study of Erosion Corrosion Behavior for Passive Metals .....	659
Comparison of Electrochemical Corrosion Performances Using Variable Scan Rates on Surfaces with Different Layer Thicknesses.....	660
Effects of Connector Placement on The Biomechanical Performance of Spinal Implants Under Tension and Compression Loads .....	661
Triboperformance of Quenched and Single and Double Tempered AISI 4140 Steel .....	662
Wave Dispersion Characteristics Of Nanorods with Uniform Porosity .....	669
The Use of a Low-Cost Laser Scanning Range Finder Sensor to Estimate the Volume of an Object .....	670
Chemical Properties of Metal Materials Used in Columns from the Hellenistic, Roman and Byzantine Periods in Stratonikeia and Lagina .....	675
The Electrochemical Behavior of Cp-Ti Coated by Ti-doped Al <sub>2</sub> O <sub>3</sub> and Ni-doped Al <sub>2</sub> O <sub>3</sub> .....	676
Determination of Cutting Parameters for Peripheral Milling of S355J Sheet Metal with Aggressive-High-Performance Machining Method.....	677
Mechanical and Tribological Properties of SLMed Silver Coated Copper Powder Material .....	682
The Effects of Selective Laser Melting Process Parameters on Thermal Conductivity of 316L Stainless Steel.....	691
Use of Phase-Changing Materials in Building Wall Blocks.....	698





Crack Path Prediction in Functionally Graded Materials Using a Local Criteria .....	706
Influence of the geometrical discontinuity on the mixed mode Crack Propagation in Functionally Graded Materials .....	707